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IS THERE LIFE ON THE OTHER WORLDS?[1]

By Sir JAMES JEANS

PROFESSOR OF ASTRONOMY

So long as the earth was believed to be the center of the universe the question of life on other worlds could hardly arise; there were no other worlds in the astronomical sense, although a heaven above and a hell beneath might form adjuncts to this world. The cosmology of the *Divina Commedia* is typical of its period. In 1440 we find Nicholas of Cusa comparing our earth, as Pythagoras had done before him, to the other stars, although without expressing any opinion as to whether these other stars were inhabited or not. At the end of the next century Giordano Bruno wrote that "there are endless particular worlds similar to this of the earth." He plainly supposed these other worlds—"the moon, planets and other stars, which are infinite in number"—to be inhabited, since he regarded their creation as evidence of the Divine goodness. He was burned at the stake in 1600; had he lived only ten years longer, his convictions would have been strengthened by Galileo's discovery of mountains and supposed seas on the moon.

The arguments of Kepler and Newton led to a general recognition that the stars were not other worlds like our earth but other suns like our sun. When once this was accepted it became natural to imagine that they also were surrounded by planets and to picture each sun as showering life-sustaining light and heat on inhabitants more or less like ourselves. In 1829 a New York newspaper scored a great journalistic hit by giving a vivid, but wholly fictitious, account of the activities of the inhabitants of the moon as seen

[1] Afternoon lecture, Royal Institution of Great Britain, November 20, 1941.

through the telescope recently erected by His Majesty's Government at the Cape.

It will be a long time before we could see what the New York paper claimed to see on the moon—bat-like men flying through the air and inhabiting houses in trees—even if it were there to see. To see an object of human size on the moon in detail we should need a telescope of from 10,000 to a 100,000 inches aperature, and even then we should have to wait years, or more probably centuries, before the air was still and clear enough for us to see details of human size.

To detect general evidence of life on even the nearest of the planets would demand far larger telescopes than anything at present in existence, unless this evidence occupied an appreciable fraction of the planet's surface. The French astronomer Flammarion once suggested that if chains of light were placed on the Sahara on a sufficiently generous scale, they might be visible to Martian astronomers if any such there be. If this light were placed so as to form a mathematical pattern, intelligent Martians might conjecture that there was intelligent life on earth. Flammarion thought that the lights might suitably be arranged to illustrate the theorem of Phythagoras (Euclid, I. 47). Possibly a better scheme would be a group of searchlights which could emit successive flashes to represent a series of numbers. If, for instance, the numbers 3, 5, 7, 11, 13, 17, 19, 23 . . . (the sequence of primes) were transmitted, the Martians might surely infer the existence of intelligent Tellurians. But any visual communication between planets would need a combination of high telescopic power at one end and of engineering works on a colossal, although not impossible, scale at the other.

Some astronomers—mainly in the past—have thought that the so-called "canals" on Mars provide evidence of just this kind, although of course unintentionally on the part of the Martians. Two white patches which surround the two poles of Mars are observed to increase and decrease with the seasons, like our terrestrial polar ice. Over the surface of Mars some astronomers have claimed to see a geometrical network of straight lines, which they have interpreted as an irrigation system of canals, designed to bring melted ice from these polar caps to parched equatorial regions. Percival Lowell calculated that this could be done by a pumping system of 4,000 times the power of Niagara. It is fairly certain now that the polar caps are not of ice, but even if they were, the radiation of the summer sun on Mars is so feeble that it could not melt more than a very thin layer of ice before the winter cold came to freeze it solid again. Actually the caps are observed to change very rapidly and are most probably clouds consisting of some kind of solid particles.

The alleged canals can not be seen at all in the largest telescopes nor can they be photographed, but there are technical reasons why neither of these considerations is conclusive against the existence of the canals. A variety of evidence suggests, however, that the canals are mere subjective illusions—the result of overstraining the eyes in trying to see every detail of a never very brightly illuminated surface. Experiments with school-children have shown that under such circumstances the strained eye tends to connect patches of color by straight lines. This will at least explain why various astronomers have claimed to see straight lines not only on Mars, where it is just conceivable that there might be canals, but also on Mercury and the largest satellite of Jupiter, where it seems beyond the bounds of possibility that canals could have been constructed, as well as on Venus, on which real canals could not possibly be seen since its solid surface is entirely hidden under clouds. It may be significant that E. E. Barnard, perhaps the most skilled observer that astronomy has ever known, was never able to see the canals at all, although he studied Mars for years through the largest telescopes.

A more promising line of approach to our problem is to examine which, if any, of the planets is physically suitable for life. But we are at once confronted with the difficulty that we do not know what precise conditions are necessary for life. A human being transferred to the surface of any one of the planets or of their satellites, would die at once and this for several different reasons on each. On Jupiter he would be simultaneously frozen, asphyxiated and poisoned, as well as doubly pressed to death by his own weight and by an atmospheric pressure of about a million terrestrial atmospheres. On Mercury he would be burned to death by the sun's heat, killed by its ultra-violet radiation, asphyxiated from want of oxygen and desiccated from want of water. But this does not touch the question of whether other planets may not have developed species of life suited to their own physical conditions. When we think of the vast variety of conditions under which terrestrial life exists on earth—plankton, soil-bacteria, stone-bacteria and the great variety of bacteria which are parasitic on the higher forms of life, it would seem rash to suggest that there are any physical conditions whatever to which life can not adapt itself. Yet, as the physical states of other planets are so different from that of our own, it seems safe to say that any life there may be on any of them must be very different from the life on earth.

The visible surface of Jupiter has a temperature of about $-138°$ C., which represents about 248 degrees of frost on the Fahrenheit scale. The planet probably comprises an inner core of rock, with a surrounding layer of ice some 16,000 miles in thickness, and an

atmosphere which again is several thousands of miles thick and exerts the pressure of a million terrestrial atmospheres which we have already mentioned. The only known constituents of this atmosphere are the poisonous gases methane and ammonia. It is certainly hard to imagine such a planet providing a home for life of any kind whatever. The planets Saturn, Uranus, Neptune and Pluto, being further from the sun, are almost certainly even colder than Jupiter and in all probability suffer from at least equal disabilities as abodes of life.

Turning sunwards from these dismal planets, we come first to Mars, where we find conditions much more like those of our own planet. The average temperature is about $-40°$ C., which is also $-40°$ on the Fahrenheit scale, but the temperature rises above the freezing point on summer afternoons in the equatorial regions. The atmosphere contains at most only small amounts of oxygen and carbon dioxide, perhaps none at all, so that there can be no vegetation comparable with that of the earth. The surface, in so far as it can be tested by a study of its powers of reflection and polarization, appears to consist of lava and volcanic ash. To us it may not seem a promising or comfortable home for life, but life of some kind or other may be there nevertheless.

Being at the same average distance from the sun as the earth, the moon has about the same average temperature, but the variations around this average temperature are enormous, the equatorial temperature varying roughly from 120° C. to $-80°$ C. The telescope shows high ranges of mountains, apparently volcanic, interspersed with flat plains of volcanic ash. The moon has no atmosphere and consequently no water; it shows no signs of life or change of any kind, unless perhaps for rare falls of rock such as might result from the impact of meteors falling in from outer space. A small town on the moon, perhaps even a large building, ought to be visible in our largest telescopes, but, needless to say, we see nothing of the kind.

Venus, the planet next to the earth, presents an interesting problem. It is similar to the earth in size but being nearer the sun is somewhat warmer. As it is blanketed in cloud we can only guess as to the nature of its surface. But its atmosphere can be studied and is found to contain little or no oxygen, so that the planet's surface can hardly be covered with vegetation as the surface of the earth is. Indeed, its surface is probably so hot that water would boil away. Yet no trace of water-vapor is found in the atmosphere, so that the planet may well be devoid of water. There are reasons for thinking that its shroud of clouds may consist of solid particles, possibly hydrates of formaldehyde. Clearly any life that this planet may harbor must be very different from that of the earth.

The only planet that remains is Mercury. This always turns the same face to the sun and its temperature ranges from about 420° C. at the center of this face to unimaginable depths of cold in the eternal night of the face which never sees the sun. The planet is too feeble gravitationally to retain much of an atmosphere and its surface, in so far as this can be tested, appears to consist mainly of volcanic ash like the moon and Mars. Once again we have a planet which does not appear promising as an abode of life and any life that there may be must be very different from our own.

Thus our survey of the solar system forces us to the conclusion that it contains no place other than our earth which is at all suitable for life at all resembling that existing on earth. The other planets are ruled out largely by unsuitable temperatures. It used to be thought that Mars might have had a temperature more suited to life in some past epoch when the sun's radiation was more energetic than it now is, and that similarly Venus can perhaps look forward to a more temperate climate in some future age. But these possibilities hardly accord with modern views of stellar evolution. The sun is now thought to be a comparatively unchanging structure, which has radiated much as now through the greater part of its past life and will continue to do the same until it changes cataclysmically into a minute "white-dwarf" star. When this happens there will be a fall of temperature too rapid for life to survive anywhere in the solar system and too great for new life ever to get a foothold. As regards suitability for life, the earth seems permanently to hold a unique position among the bodies surrounding our sun.

Our sun is, however, only one of myriads of stars in space. Our own galaxy alone contains about 100,000 million stars, and there are perhaps 10,000 million similar galaxies in space. Stars are about as numerous in space as grains of sand in the Sahara. What can we say about the possibilities of life on planets surrounding these other suns?

We want first to know whether these planets exist. Observational astronomy can tell us nothing; if every star in the sky were surrounded by a planetary system like that of our sun, no telescope on earth could reveal a single one of these planets. Theory can tell us a little more. While there is some doubt as to the exact manner in which the sun acquired its family of planets, all modern theories are at one in supposing that it was the result of the close approach of another star. Other stars in the sky must also experience similar approaches, although calculation shows that such events

must be excessively rare. Under conditions like those which now prevail in the neighborhood of the sun, a star will only experience an approach close enough to generate planets about once in every million, million, million years. If we suppose the star to have lived under these conditions for about 2,000 million years, only one star in 500 million will have experienced the necessary close encounter, so that at most one star in 500 million will be surrounded by planets. This looks an absurdly minute fraction of the whole, yet when the whole consists of a thousand million million million stars, this minute fraction represents two million million stars. On this calculation, then, two million million stars must already be surrounded by planets and a new solar system is born every few hours. The calculation probably needs many adjustments; for instance, conditions near our sun are not at all typical of conditions throughout space and the conditions of to-day are probably not typical of conditions in past ages. But even so the calculation suggests, with a large margin to spare, that although planetary systems may be rare in space, their total number is far from insignificant. Out of the thousands or millions of millions of planets that there must surely be in space, a very great number must have physical conditions very similar to those prevailing on earth.

We can not even guess whether these are inhabited by life like our own or by life of any kind whatever. The same chemical atoms exist there as exist here and must have the same properties, so that it is likely that the same inorganic compounds have formed there as have formed here. If so, we would like to know how far the chain of life has progressed but present-day science can give no help. We can only wonder whether any life there may be elsewhere in the universe has succeeded in managing its affairs better than we have done in recent years.

THE MECHANISM OF SPECIES ADAPTATION TO CARCINOGENS

By Dr. R. R. SPENCER, Assistant Chief

AND

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INTRODUCTION

THAT the cancer cell is the result of a slow process of adjustment of normal cells to an unusual environment over a period of time embracing several or many cell-division cycles is the simple hypothetical basis upon which the experiments described herein were undertaken. The concept is not new, but as far as known, little if any experimental evidence has been produced in support of it. Therefore it was thought that some light might be thrown on the process of cancer induction by observing the behavior of small free-living organisms in the presence of carcinogenic agents over a considerable period of the racial history involving numerous successive generations.

We do not believe that the past experience of cancer investigators, either in the clinical or in the experimental fields, warrants the assumption that the genesis of a cancer cell involves a sudden change of a normal cell. All pathological entities barring those due to wounds and hereditary defects are the result of a process—a process of adjustment to an unusual or unfavorable environment. Cancer, we suspect, is no exception unless it be that the process here is slower than in most other diseases, and this slowness may be due in part to the fact that the genetic mechanism of the cell is primarily affected.

The clinically observed association of cancer with chronic irritation, the prolonged incubation period in experimentally induced cancer and the various precancerous lesions and stages that have been described, all seem to fit in with the concept of *gradualism* as a reasonable hypothesis in the genesis of cancer. The clinical examples of a step-like derivation of malignant growth does not exclude completely, of course, the alternative concept of a sudden mutational change as an occasional mechanism, for it is true that mutations can be induced experimentally with some of the same agents that are known to induce cancer and as the result of a single stimulus of great magnitude (x-rays, gamma rays of radium, heat). Such agents may either destroy one or more genes or disarrange the genic pattern and sequence. But in nature these highly artificial procedures are certainly the exceptions rather than the rule. It seems reasonable then to assume that a genetic change may be very frequently the culmination of a series of subliminal stimuli which have extended through many cell-divisions or generations.

The successful immunization of individual animals to multiple lethal doses of various toxins is well known, and can be achieved best by means of interval injections of increasing doses over a considerable

period. Naturally one suspects that the permanent and successful adaptation of a race or species in contrast to the adjustment of the individual cell or organism would require a much longer time. However, it is believed that the underlying biochemical mechanism of species adaptation must of necessity be basically similar to the mechanism of adjustment of an individual organism.

For the past three years our experiments have been concerned with species adaptation of small organisms to carcinogenic agents. The results have led us to the suggestion that a cancer cell is a normal cell that has been able to make a more or less successful adjustment to an unusual environment—successful only from the standpoint of the cell itself. The adjustment is, of course, a fatal one from the standpoint of the organism as a whole. The continuous exposure of several widely separated species (bacteria, paramecia and worms) to such agents has yielded very different results. Nevertheless, there has been a certain consistency to which we now wish to invite attention and which we believe gives us a little better insight into the process by which species gradually become adapted to specific environments.

It is believed that the experiments here described yield convincing evidence that an individual can readily withstand an environment which will ultimately kill the species, provided the exposure is continued over a sufficient number of successive generations. In other words an environment which has no visible or measurable deleterious effect on individual organisms at first and in fact may display a stimulating effect for a number of generations will nevertheless finally weaken and in some cases destroy the species, provided the exposure is continuous.

A. Results with Bacteria

In our first experiment[1] a strain of bacteria (*Eberthella typhi*) was treated continuously with methylcholanthrene (1 mgm in 10 cc of medium) for 240 consecutive daily transfers.

Besides an initial stimulation of cell-division rate, the only definite change noted was that the amount of visible growth in the culture tubes of the latter end of the series (two-hundredth to the two-hundred and fortieth) was considerably less than in the tubes of the first part of the series or of any of the tubes of the control series, as determined by the degree of turbidity. This suggested a gradual weakening of the strain of organisms, since all tubes contained the same amount of plain broth from the same batch. In further support of this, it was also observed that a much larger amount of inoculum from the latter tubes of the methylcholanthrene-treated series (two-hundredth to two-hundred and fortieth tubes) was needed in order to obtain a good growth and distribution of colonies on agar slants, although at the time of transplantation these latter cultures were not as old and had been incubated (37° C) for a less number of days than those of the first part of the series. At that time, the experiment was thought to have yielded essentially negative results and so was discontinued. In the light of subsequent observations on paramecia, however, it is believed now that a further weakening of the strain would have been apparent had the experiment been continued.

B. Results with Paramecia

A strain of *Paramecium multimicronucleatum* has been exposed continuously to methylcholanthrene (1 mg per litre of medium) since May 8, 1939, to the present writing—January, 1942. Cultures have been transferred every ten days. For the first 20 to 30 transfers neither structural nor functional differences could be noted between the organisms in the control and in the methylcholanthrene-adapted series.

From the thirty-fifth to the forty-fifth transfer, however, a striking increase in the viability of the methylcholanthrene-treated organisms was apparent. The details of these tests have also been reported.[2]

Still later in the process of adaptation to methylcholanthrene (fiftieth to seventy-fifth transfer) the organisms displayed a further change in their behavior. At this time they had acquired the ability to reach population levels far higher than control organisms which at all periods throughout the more than 2-year adjustment period have displayed a fairly constant functional pattern as measured by our viability tests.[3]

The exposure of paramecia to methylcholanthrene has now reached the eightieth transfer and the organisms are displaying a loss of their former toughness and a decrease in their ability to reach high population levels. Repeated tests now indicate that they are far weaker than the corresponding unexposed control organisms. Structural changes have not been observed. The process of adjustment is being continued.

Paramecia exposed to the noncarcinogen but closely related polycyclic hydrocarbon phenanthrene in the same concentrations (1 mg per litre) multiplied for 3 transfers and the organisms were not apparently affected but the fourth transfer died. As a rule, we have found noncarcinogens more toxic than carcinogens. In our experience, untreated controls have always survived upon transfer and are as vigorous now on the ninetieth transfer as they were at first.

Paramecia were also exposed continuously to eosin in 10 separate series of dilutions graded from 1–1,000

[1] R. R. Spencer and M. B. Melroy, *Jour. Nat. Cancer Inst.*, 1: 129–134, 1940.

[2] *Idem, Jour. Nat. Cancer Inst.*, 1: 343–348, 1940.

[3] *Idem, Jour. Nat. Cancer Inst.*, 2: 185–191, 1941.

to 1–10,000. The organisms exposed to 1–10,000 eosin have grown and multiplied continuously for 85 ten-day transfers over a period of 2 years and 9 months. They have gradually become smaller in size than the control series, and this eosin-treated strain is slowly losing its vigor as measured by our viability tests referred to above. In fact, the organisms in the 1–1,000, 1–2,000 and 1–3,000 series thrived for 18 transfers, but it was not possible to make successful transfers afterward. Thus the strain was destroyed by long and continuous exposure to an environment which did not at first affect individuals in any measurable way.

C. Results with a Species of Worm

Confirmatory and perhaps more convincing results have been obtained with a small flat worm, *Stenostoma tenuicaudatum*. The methods and details of this experiment will be published later. This species was exposed continuously to methylcholanthrene, to phenanthrene and to the gamma rays of radium (33 mg). At the same time a continuous series of untreated control cultures were carried. Transfers were made every 14 days. Each transfer consisted of 12 worms. Population counts were made on the forty-fifth day after transplantation. The methylcholanthrene-treated worms maintained consistently higher population levels over a period of 30 transfers (March, 1940, to May, 1941). This series has now (January, 1942) been transferred 43 times. Since the thirtieth transfer the populations have sometimes been above and sometimes below the control. The adjustment process is being continued.

The phenanthrene-treated series of worms, however, thrived for eight transfers, reaching much higher levels than the controls on the sixth transfer. The worms in the ninth culture dish of this series died. To prove that there was no substance in this dish fatal to the worms, twelve untreated control worms were added to it. They multiplied readily.

The same phenomenon was manifested with a series of worm cultures irradiated continuously with 33 mg of radium. The worms thrived in the presence of radium for nine transfers. On the seventh transfer the population was higher than the corresponding control or that of any of the other treated series. In the eighth and ninth culture of the series, however, the number of worms was greatly reduced. For this reason, the amount of radium was reduced from 33 to 23 milligrams. From the tenth to the twenty-second culture the worms again grew well and the populations remained sometimes above and sometimes below those of the control series. After the twenty-second culture, the populations of each successive dish diminished. All died on the thirtieth transfer. Thus it seemed that radiations from radium which manifested no deleterious effects on the individual worms of the first eight transfers were able later to destroy the species at the thirtieth transfer, even though the intensity of the irradiation was decreased at the tenth transfer.

Discussion

It is believed that the above-outlined tests suggest the existence of a cumulative effect upon a species exposed *continuously* to an unusual environment covering many cell-division cycles or generations. These experiments have also suggested to us that an alternating or rhythmic rather than a continuous exposure of a species to a harsh environment may yield more interesting and perhaps more significant results—results that may shed further light on the basic principles of species adaptation. In fact, recently inaugurated experiments in which bacteria have been exposed to unfavorable agents already have shown that such organisms can resist and adapt to much harsher environments when the exposure is rhythmic than when it is continuous. It may be that a period of rest and recuperation is necessary to the successful adjustment of all living things regardless of whether we have in mind a species or an individual of the species. Rhythmicity is an almost universal phenomenon in nature, but not many biological experiments have been devised to study the effects of a rhythmic exposure to unfavorable conditions.

In this connection it is recalled that Magoon,[4] of the U. S. Bureau of Plant Industry, showed that, contrary to the commonly accepted idea that bacterial spores once formed have a fixed resistance, have in reality a resistance which varies with age and with the conditions under which the spores exist. He was able to demonstrate that bacterial spores of *B. mycoides* derived from heat-resistant survivors in thermal death time tests possessed higher resistance to heat than the original spores and by a process of selection, a strain of bacteria was obtained whose spores attained a resistance to heat at least 25 times that of the original spores. Magoon was interested in determining the heat necessary to destroy spore-bearing organisms in canned goods.

Armstrong,[5] of the U. S. Public Health Service, attempted to develop a vaccine virus that would keep at room or body temperatures. He exposed the virus to incubator temperature (37.5° C.) and by continued selection and propagation of the virus in the rabbit was able to develop a strain which showed an "increase of several hundred per cent. in the period of time during which it will withstand a temperature of 37.5° C. and still give typical skin takes on rabbits." A notable increase in the virulence of the virus for animals was also noted, and this feature deterred him from employing the strain in man.

[4] C. A. Magoon, *Jour. Inf. Dis.*, 38: 429–439, 1926.
[5] C. Armstrong, *Pub. Health Rep.*, 44: 1183–1191, 1929.

Neither Magoon nor Armstrong mentioned the principle of rhythmic exposure to an unfavorable environment as a possible factor of broad application in the study of the mechanism of species adaptation, although their technique involved this principle.

Huntington[6] is the only investigator of whom we are aware who has presented data and observations emphasizing the importance of an alternating environment. Huntington's thesis is that the highest human civilizations have arisen only in areas where there was an alternating climate. Continuously hot or continuously cold climates are enervating. A changeable climate is stimulating. A thorough search of the biological literature may reveal other examples that, in the light of our experiments, may now suggest the general biological importance of rhythmic exposure to unfavorable environments.

SUMMARY

(1) Three widely separated species have been exposed *continuously* to carcinogenic and other agents over a considerable period of time and throughout many cell-division cycles.

(2) Evidence is presented to show that each of these species may be weakened and in some cases destroyed when exposed to amounts of these unfavorable agents which have no measurable deleterious effect on individual organisms, but which may in some cases at first be stimulating. The biological generalization that certain environments may be ontogenetically harmless but phylogenetically lethal is suggested.

(3) Preliminary tests suggest also that a *rhythmic* rather than a *continuous* exposure of a species to harsh environments may be a very useful technic to employ in the study of the mechanism of species adaptation.

OBITUARY

SIR WILLIAM BRAGG

ON Thursday, March 12, in the passing of Sir William Bragg, death robbed physics of one of its most illustrious ornaments and all science of one of its best loved friends.

In an age when so much of discovery falls to the lot of youth, it is a comfort to ponder the cases in history which stand as proof that middle age does not always spell the death of originality and that maturity provides its own special seasoning in the realms of discovery, a seasoning which science would miss greatly were it deprived of it. Sir William Bragg stands as an example of rich development in years in which the prime of youth has passed; for though, naturally, he was a successful student and an eminently successful teacher, it was not until eighteen years after his departure from Cambridge to accept the professorship of mathematics and physics at the University of Adelaide that he published his first paper when he was more than 40 years old. It is very evident, however, that in the years which had preceded, there had been a great strengthening of mental forces to the point of readiness for service when once released in the search for new truth, for within three years of his first publication he had become a fellow of the Royal Society, and from that time onwards he was a continual contributor to the journals of science.

Bragg's first paper on the range and ionization of alpha particles is one of the fundamental stepping-stones in the science of radioactivity, and he continued to contribute richly to that field, partly in collaboration with Kleeman. In 1908 he returned to England as professor of physics at the University of Leeds, and it was not long before he became interested in x-ray research, coming into that field at a time when, with the principles of the quantum theory knocking at the doors of science, conventional electromagnetic views as to the behavior of nature held powerful sway in the halls of learning. Bragg was a strong advocate of the particle nature of x-rays and, while none can doubt the broadness of his concepts of the nature of what was then termed a particle, his natural desire for simplicity of expression caused his writings to take a form which invited considerable controversy with the extreme opposed school, represented prominently at the time by C. G. Barkla, who desired to retain classical electrodynamics in as pure a form as possible. It is characteristic of Bragg's broadness of view and his adaptability to changing pictures that, following von Laue's fundamental discovery in x-ray diffraction, he entered that field with enthusiasm and, in collaboration with his son, William Lawrence Bragg, became the most prominent worker in the field which established the science of x-ray spectroscopy. He was at Leeds when the war of 1914–18 broke out, but he became professor of physics at University College, London, in 1915. Most of his time during the war was devoted to government work and he became director of the Royal Institution and the Davy-Faraday Research Laboratory in 1923. In this position his powers reached their maximum field of usefulness. Endowed with all the personal charm so essential to the office, he was a worthy successor to Faraday, not only as a fruitful investigator, but also as an inspiring speaker possessed of a gift for lucidity which made his lectures a joy, both to the man of science and to the layman.

[6] Ellsworth Huntington, "Civilization and Climate." Yale University Press, 1922.

Bragg was keenly interested in the history of the Royal Institution and in the work of his great predecessor, Michael Faraday. He played a very prominent part in the publication of Faraday's diary and was responsible for bringing about a very delightful occasion when at the institution—the centenary of Faraday's discoveries, which was celebrated in 1931.

Sir William Bragg was born on July 2, 1862, at Wigton, Cumberland, England. In Adelaide he married Gwendoline, daughter of Sir Charles Todd, and had three children, Sir Lawrence Bragg, now at the University of Cambridge, Gwendy, now Mrs. Alban Caroe, and Robert. He was the recipient of many honors, among them the Order of Merit, the Nobel Prize for physics, the Rumford and Copley Medals, the Barnard Medal of Columbia University, and the Franklin Gold Medal of the Franklin Institute. He served as president of the British Association for the Advancement of Science and from 1935–40 was president of the Royal Society of London.

Sir William was noted for his kindly disposition and his courtesy to all. He had a simplicity of manner which endeared him both to his intimate colleagues and to those whom he met casually. Death has dealt heavily with physics during recent years. First Lord Rutherford, then his old professor, Sir J. J. Thomson, next the oldest of them all, Sir Oliver Lodge, and, finally, Sir William Bragg have been gathered to the halls of the illustrious dead. It is a grand and noble company which thus carries to Valhalla the records of achievement of the most fruitful epoch in the whole history of science.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE,
SWARTHMORE, PA.

DEATHS AND MEMORIALS

DR. WILLIAM LOGAN BENITZ, since 1896 professor of mechanical engineering at the University of Notre Dame until his retirement with the title emeritus in 1939, died on June 1. He was sixty-nine years old.

DR. JOSEPH HYDE PRATT, consulting engineer and geologist, from 1904 to 1926 professor of economic geology at the University of North Carolina and from 1905 to 1924 state geologist, died on June 2, at the age of seventy-two years.

DR. DONALD FRANCIS MACDONALD, consulting geologist for the Panama Canal Zone, formerly professor of geology at St. Francis Xavier University, Nova Scotia, died on May 29 in his sixty-seventh year.

DR. MILLARD MANNING, assistant professor of physics at the University of Pittsburgh, died on June 1, at the age of thirty-six years.

THE REV. DR. THEODORE EVELYN REECE PHILLIPS, rector of Headley, Epsom, from 1916 to 1941, a past president of the Royal Astronomical Society and the British Astronomical Association, died on May 13, at the age of seventy-four years.

DR. G. G. STONEY, consulting engineer, from 1917 to 1926 professor of mechanical engineering in the College of Technology and in the Victoria University, Manchester, from 1926 to 1930 director of research at C. A. Parsons and Company, died on May 15 in his seventy-ninth year.

TAU CHAPTER of Nu Sigma Nu at Cornell University Medical College has voted to name its annual lectureship for Walter L. Niles, dean of the college for many years and at the time of his death in December, 1941, acting dean. A fellowship in the department of medicine at Cornell also has been established in Dr. Niles's memory.

SCIENTIFIC EVENTS

DRUG CONTROL IN INDIA

Nature gives an account of progress in the problem of drug standardization and control in India.

In January, 1937, the nucleus of a central laboratory, the Biochemical Standardization Laboratory, was established, under the direction of Sir R. N. Chopra, in Calcutta, at the All-India Institute of Hygiene and Public Health. The laboratory has now made satisfactory progress in the limited number of studies undertaken and has trained adequate personnel and laid sure foundations for future work in this field as evidenced in the triennial report of the laboratory. During the three years preceding the introduction of the Drugs Bill in February, 1940, it was thought that the best course for the laboratory was to undertake a general survey of the quality of medical drugs in the Indian market and an examination of the specimens of drugs both imported and manufactured in India which were suspected to be of inferior quality.

Many drug manufacturing firms in India do not maintain properly equipped pharmacological laboratories with trained personnel capable of undertaking the standardization of chemotherapeutic preparations, and it was natural that ethical manufacturing concerns interested in the quality of their products should approach the only government organization available with requests to have their products standardized.

In the initial stages the laboratory had necessarily to restrict itself to certain definite drugs of com-

paratively greater importance to the pharmaceutical and medical professions. Routine analytical work was therefore largely concentrated on surveying the quality of tinctures of digitalis, strophanthus and squills, extract of posterior pituitary gland and adrenaline hydrochloride solution. In addition to the routine activities a good deal of interest in research problems on subjects which have a direct or indirect bearing on drug work was consistently maintained. For example, one of the first group of drugs which the laboratory investigated was the cardiac drugs of the digitalis series. Liquid preparations of these drugs deteriorate at a fairly rapid rate when stored under the climatic conditions existing in India, and factors leading to this deterioration and loss of potency have been the subject of investigation. Again, the estimation of the antidiuretic potency of pituitary extract in rats was given an extensive trial and found to be quite reliable and to compare favorably with the results obtained by the oxytocic method. In addition, the laboratory has the responsibility of acting as the national center for the maintenance and distribution of certain international surgical standards.

CONSERVATION AND SOUTH AMERICAN EXPEDITIONS

Two projects are announced by the National Park Service, whereby this agency will cooperate in encouraging mutual understanding of conservation problems between the Americas.

A combined plant-hunting expedition and lecture tour in South America is being undertaken by Dr. T. Harper Goodspeed, director of the Botanical Garden at the University of California and a collaborator of the National Park Service. His expedition is a joint project in which the University of California and South American institutions are cooperating. Well known to both continents, because of two other scientific trips to South America in 1935–36 and 1938–39, and author of the recently issued book, "Plant Hunter in the Andes," Dr. Goodspeed has been invited to lecture in Spanish and Portuguese in Argentina, Brazil, Chile, Colombia, Peru and Uruguay. His lectures will include color motion pictures of the National Parks of western United States and deal with wildlife conservation.

A Roosevelt Fellowship for study in South America has recently been awarded to Julian Vogt, ranger naturalist successively in six western National Parks. This traveling fellowship of the Institute for International Education was established by the Office of the Coordinator of Inter-American Affairs, which has financed the project. Ten United States students have been awarded these exchange fellowships, and one student in each of the twenty other American republics. In announcing the project, the coordinator, Nelson Rockefeller, stated:

> The 21 American republics confidently face the future together, during the war and after. The scholarship program which the American republics have jointly arranged affords another strong bond to assure the cooperation essential to victory and stable peace.

Mr. Vogt, a graduate of the University of California, will study at the University of Buenos Aires, concentrating on South American policies of conservation. He will also visit the National Parks and reservations of various countries in South America.

THE FLORA OF CUBA

BROTHER LÉON (Joseph Sylvestre Sauget y Barbier), for many years a professor on the staff of the Colegio de la Salle, Vedado, Havana, Cuba, has received a special grant from the Milton Fund, Harvard University, to be utilized by him in preparing for publication a comprehensive work on the flora of Cuba.

Throughout his long residence in Cuba, Brother Léon has devoted a large amount of time to accumulating data on the flora of Cuba, and from his wide experience is eminently fitted to consummate the task to which he has set his hand. Some years ago, in recognition of his accomplishments as a botanist, he was the recipient of an honorary doctorate of science from Columbia University.

Brother Léon was appointed as collaborator on the staff of the Atkins Institution of the Arnold Arboretum, Harvard University, in 1938, in appreciation of his botanical accomplishments. In furtherance of the cooperative work on the flora of Cuba between Harvard and other institutions, may be mentioned the recently published, copiously illustrated volume of 496 pages by Brother Léon and Brother Marie-Victorin, entitled "Itinéraires botaniques dans l'île de Cuba," issued in 1942 by the Botanical Laboratory of the University of Montreal. Publication was made possible through a subvention to the University of Montreal, through the Atkins Institution. The Milton Fund grant to Brother Léon is further evidence of interest in this field of international cooperation. It is the first time that a grant from this fund has been made available for expenditure through an institution outside of the United States, thus forming an excellent illustration of inter-American collaboration.

NEW YORK CHAPTER OF THE SCIENCE SOCIETY OF CHINA

A NUMBER of Chinese scientists in New York City have joined in forming an organization known as "The Science Society of China, New York Chapter." This society was organized originally at Cornell University in 1914 and later was established in China in

1918. Its object is to promote better understanding and cooperation among the Chinese research workers in the United States of America in order to contribute to the advancement of the various branches of science, both natural and social.

The activities of the society for the present consist in promoting lecture meetings for scientific discussions at which distinguished speakers will address the meeting.

The officers of the society have been elected as follows:

President: John Y. C. Watt, Cornell University Medical College.

Vice-president: Chek M. Soo-Hoo, Presbyterian Hospital, New York City.

Secretary: Roberta Ma, New York Botanical Garden.

Treasurer: Raymond Yoh, Bank of China, New York City.

Members of the Committee: Katherine Li, Memorial Hospital, New York City; Min Pung Tien, Columbia University; Van Y. S. Hong, Syracuse University.

THE AMERICAN COMMISSION ON SCIENTIFIC NOMENCLATURE IN ENTOMOLOGY

THE disturbed condition of the world during the last few years has interfered with the activities of the International Commission on Zoological Nomenclature, and there is no prospect that this commission will again function successfully for several years to come. Entomologists in the United States have felt that this situation should not be allowed entirely to stifle progress in the development of nomenclature and the clarification of nomenclatorial problems. At the meetings of the Entomological Society of America and the American Association of Economic Entomologists in San Francisco, in December, 1941, a plan was adopted which called for the establishment of an American Commission on Scientific Nomenclature in Entomology.

In accord with the terms of this plan, C. F. W. Muesebeck and Professor G. F. Ferris were appointed to organize the commission. That organization has now been completed and the commission is ready to function. It includes Professor J. C. Bradley, of Cornell University; W. J. Brown and G. Stuart Walley, of the Division of Entomology of the Department of Agriculture of Canada; Professor G. F. Ferris, of Stanford University; Professor T. H. Hubbell, of the University of Florida; Professor H. B. Hungerford, of the University of Kansas; Dr. E. G. Linsley, of the University of California; Professor Clarence E. Mickel, of the University of Minnesota; C. F. W. Muesebeck and P. W. Oman, of the U. S. Bureau of Entomology and Plant Quarantine; Professor A. G. Richards, Jr., of the University of Pennsylvania; Dr. Herbert H. Ross, of the State Natural History Survey of Illinois; Professor C. W. Sabrosky, of the State Agricultural College of Michigan; Dr. R. L. Usinger, of the College of Agriculture of California. Professor G. F. Ferris has been elected as chairman.

The commission will receive, consider and advise upon such nomenclatorial problems as are presented to it. All acts of the commission will be in harmony with the International Rules of Zoological Nomenclature, although recommendations for the clarification, extension and improvement of these rules may be made. The commission will report to the two parent societies at their next annual meeting. Communications concerning matters within the province of the commission may be addressed to any of its members.

G. F. FERRIS

MEETING OF EXPERIMENTAL BIOLOGISTS IN OREGON

A MEETING of experimental biologists was held at Portland, Oregon, on May 9.

Forty-seven workers from colleges and universities in the States of Oregon and Washington attended the meetings, during which papers were presented on varied subjects ranging from plant and animal physiology to ecology, embryology and genetics, and so forth.

The meeting was organized as the result of a general agreement as to the need for some annual meeting at which biologists interested in experimental work in the Pacific Northwest could get together. Held at Reed College, the program of papers was followed by a dinner at which the subject of the future organization of the group as well as the need for a general biological society in the region was discussed.

It was agreed that for the time being, at least, the organization should remain informal, though with the papers limited to the experimental fields, and that it should remain affiliated with no existing society or institution. It was agreed that the diversity of the subjects in the program as well as the general informality of the meeting were factors contributing to its success.

Dr. Orlin Biddulph, plant physiologist of the State College of Washington, was elected to head a committee to organize a similar meeting in the spring of next year.

SCIENTIFIC NOTES AND NEWS

COLUMBIA UNIVERSITY conferred on June 2 at its 188th commencement exercises the doctorate of science on Dr. Jekuthiel Ginsburg, professor of mathematics and head of the department at Yeshiva College; on Dr. Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania; on Dr. Robert

R. Williams, chemical director of the Bell Telephone Laboratories, and on Dr. Roger John Williams, professor of chemistry at the University of Texas.

THE doctorate of laws was conferred on June 2 at the commencement exercises of the University of Pennsylvania on Dr. Vannevar Bush, president of the Carnegie Institution of Washington and director of the Office of Scientific Research and Development.

THE doctorate of science was conferred by Ohio Wesleyan University, at the recent centennial exercises, on Dr. Arthur Bevan, of the class of 1912, State Geologist of Virginia since 1929.

PARK COLLEGE on May 25 conferred the honorary doctorate of science on Dr. Ross A. McFarland, of Harvard University, who gave the commencement address. The honorary degree of doctor of laws was conferred on Dr. Paul Prentice Boyd, professor of mathematics and dean of the College of Arts and Sciences of the University of Kentucky.

AT the commencement exercises of the Michigan College of Mining and Technology, honorary degrees were conferred on the commencement speaker, Dr. Robert C. Wallace, and on Harlan S. Emlaw, mining engineer and industrial leader, of New York City, of the class of 1895. Dr. Wallace is principal of Queen's University, Kingston, Ontario, and has served as president of the Canadian Institute of Mining and Metallurgy.

MIDDLEBURY COLLEGE, at its commencement on May 25, conferred on Dr. James Montrose Duncan Olmsted, professor of physiology at the University of California, the degree of doctor of science. Dr. Olmsted gave the Phi Beta Kappa address on "The Place of Physiology in a University Curriculum."

THE Duddell Medal of the Physical Society, London, which was awarded to Dr. William David Coolidge in recognition of his pioneer work in the production of ductile tungsten and of his invention and the subsequent development of the hot-cathode high-vacuum x-ray tube, was formally presented to him on May 1 by Viscount Halifax, British Ambassador to the United States, at a dinner of the American Physical Society at Baltimore.

THE Cornelius Amory Pugsley Gold Medal of the American Scenic and Historic Preservation Society was presented on June 2 to Harold L. Ickes, Secretary of the Department of the Interior.

DR. ESTHER CARPENTER, assistant professor of zoology at Smith College, has been awarded the Elizabeth Clay Howald scholarship of the Ohio State University for the coming year. The scholarship, carrying an annual stipend of $3,000, was endowed by the late Ferdinand Howald, in memory of his mother, and goes each year to "a person who has shown marked ability in some field of study and has in progress work the results of which promise to constitute important additions to our knowledge."

DR. EDWARD ADLER has been awarded the Author's Prize of $100 by the Electrochemical Society for the best paper of the year 1941, published in the *Transactions* of the society.

DR. J. B. COLLIP, head of the department of biochemistry of McGill University, was elected on May 30 to succeed Judge F. W. Howat, of New Westminster, B. C., as president of the Royal Society of Canada.

NEWLY elected officers of the Sigma Xi Club of the University of Tennessee are Dr. Samuel L. Meyer, botany, *President;* Dr. Edgar D. Eaves, mathematics, *Vice-president;* and Dr. Samuel H. Winterberg, soil chemistry, *Secretary-Treasurer.*

AT the meeting of the American Branch of the International League against Epilepsy, held in Boston on May 18, the following officers were elected: *President,* Wilder G. Penfield, Montreal; *Vice-president,* Charles D. Aring, Cincinnati; *Secretary-Treasurer,* Frederic A. Gibbs, Boston.

DR. JOHN BITTING SMITH NORTON, of the University of Maryland, having reached the retirement age, was made on April 1 professor emeritus in the departments of plant pathology and botany. Officers of the department of botany honored Dr. and Mrs. Norton at a banquet on April 7, when he was presented with tokens of esteem by his colleagues and former students. He will continue work on the university botanical herbarium and will carry on projects in plant breeding and taxonomy.

DR. CHARLES BROOKS, plant pathologist of the U. S. Department of Agriculture, who was retired on April 30, has accepted a research position with the Brogdex Company, of Pomona, Calif.

DR. WILLIAM R. WORK, since 1921 head of the department of electrical engineering at the Carnegie Institute of Technology, Pittsburgh, has been appointed assistant director of the College of Engineering.

DR. C. E. F. GUTERMAN, assistant director of the Agricultural Experiment Station at Cornell University, has been made director of the station.

DR. ALFRED C. REED has resigned as professor of tropical medicine at the University of California, and has become associate clinical professor of medicine at the Stanford University Medical School.

DR. GEORGE D. STODDARD, head of the department of psychology, dean of the Graduate College of the State University of Iowa and director of the Iowa Child Welfare Research Station, will take up his work as New York State Commissioner of Education on July 1.

DR. WILLIAM OTIS HOTCHKISS, since 1935 president of the Rensselaer Polytechnic Institute, has been made assistant director general of the Army Specialist Corps.

ADOLPH G. ROSENGARTEN, JR., has resigned as director of Merck and Co., Inc., Rahway, N. J., because of duties with the Army, and is succeeded by his uncle, J. G. Rosengarten, Jr.

IT is reported in the London *Times* that Dr. C. K. Mingle has been released from the U. S. Department of Agriculture at Washington to cooperate with British scientific men in the prevention of contagious abortion, a disease which, it was estimated just before the war, cost Great Britain more than £10,000,000 a year through reduced milk production and loss of cattle.

DR. ALFRED C. KINSEY, Indiana University, is in charge of the research project on human sex behavior for which the Committee for Research on Problems of Sex of the National Research Council has made a grant of $7,500 for use during the coming year. The research program has been under way for four years. During the past year, it was supported jointly by Indiana University and a grant from the National Research Council. Clyde E. Martin and Glenn Ramsey are collaborators in the research.

THE commencement address at Rutgers University was delivered by Dr. Cecilia Payne Gaposchkin, astronomer at the Harvard College Observatory.

DR. MELVILLE J. HERSKOVITS, of Northwestern University, who is at present engaged in anthropological field-work in Brazil, on May 6 delivered an address inaugurating the educational activities of the newly formed faculty of philosophy of Bahia.

A PSYCHOLOGICAL examiner is being sought by the Los Angeles County Civil Service Commission to use psychological tests and other clinical techniques in the study of juveniles, and to make interpretations and recommendations on the basis of the tests given. University graduates, aged from 21 to 55 years, with a Ph.D. in psychology and 500 hours of clinical experience, or a master's degree in psychology and 1,000 hours of clinical experience, should file applications at 102 Hall of Records in Los Angeles on or before June 19.

DR. LLOYD W. FISHER, of Bates College, writes that it seems inadvisable to conduct the New England Intercollegiate Geological Excursion in the autumn. It has also been suggested that no trips be held for the duration of the war.

THE Brush Foundation, which is affiliated with the Western Reserve University School of Medicine, has received from an anonymous donor a gift of $250,000 to be used for the research and educational work of the foundation under the supervision of Dr. William Walter Greulich, director of the Brush Foundation and professor of physical anthropology and anatomy in the School of Medicine.

THE Committee on Scientific Research of the American Medical Association has made the following grants: Barnett Sure, University of Arkansas, vitamin B complex; Paul Thomas Young, University of Illinois, appetite and food preferences in the rat; Deborah V. Dauber, Michael Reese Hospital, Chicago, atherosclerosis in the chick (Jay Conger Davis Research Fund); Milton Mendlowitz, Mount Sinai Hospital, New York, digital circulation (Jay Conger Davis Research Fund); Jacob Rabinovitch, Jewish Hospital of Brooklyn, effect of heparin on thrombosis; and Robert W. Virtue, University of Denver, sulfur metabolism in cystinuric dogs.

AN Associated Press dispatch from Calcutta dated May 19 states that fifteen physicians and scientific men of the U. S. Public Health Service mission, who directed malaria control and sanitation for approximately 200,000 workers on the Yunnan-Burma Railway, escaped from territory overrun by the Japanese and are awaiting reassignment in India. The mission, headed by Dr. Victor H. Haas, of Memphis, Tenn., had been working since October in the southernmost 300 miles of the 700-mile route which was to link Kunming with Lashio to speed defense supplies to China. William Jellison, of Hamilton, Mont., and Henry A. Johnson, sanitary engineer, of Memphis, saved $5,000 worth of microscopes and other scientific apparatus when they left Yun Hsien.

THE new research laboratories of the Overly Bio-Chemical Research Foundation, at 254 West 31st Street, New York City, are nearing completion. The foundation has recently been incorporated under the laws of the State of New York as a non-profit research organization which for the duration of the war will devote its work to problems of interest to military medicine, and which later on will deal with fundamental problems in biochemistry. The staff includes Dr. Kurt G. Stern, protein research chemist, formerly of the Yale Medical School; Dr. Arthur L. Schade, bacteriologist; and James S. Wallerstein, biological chemist, who is also president of the foundation. The scientific policies of the foundation are determined

by a board of scientific directors whose members include Dr. Dean Burk, of the National Institute of Health; Dr. Leo Edelman, Dr. Leo Stieglitz and Dr. O. Alan Rose, all of New York City.

ACCORDING to the *Experiment Station Record,* a grant of $150,000 from the General Education Board for the conduct of a five-state regional study of land tenure and farm labor problems has been announced at the University of Arkansas. The university has been designated as fiscal agent. The research will include field studies of land tenure and farm labor problems in Arkansas, Mississippi, Louisiana, Texas and Oklahoma. A regional staff, headed by Dr. H. C. Hoffsommer, professor of rural sociology and sociologist at Louisiana State University and Station, will be employed, and a regional research laboratory will be set up at the university on a three-year basis. The project will be under the direction of the southwestern land tenure research committee, of which Dr. C. O. Brannen, head of the department of rural economics and sociology and assistant director of research, is chairman.

THE American Coordinating Committee on Corrosion is planning a revision of its confidential Directory of Technologists actively engaged in studies on corrosion and its prevention. The committee comprises delegates from the seventeen major technical societies together with representatives from the principal industrial research institutes and the National Bureau of Standards. Its directory lists some four hundred investigators in corrosion-preventive fields, selected on the basis of questionnaires circulated to the member societies of the committee. It requests that all those actively engaged in corrosion researches who have not received applications for information from the committee write to the secretary, Dr. G. H. Young, 4400 Fifth Avenue, Pittsburgh, Pa., for further details and application forms for directory listing.

DISCUSSION

SOIL FERTILITY AND MANURING IN CHINA

BEGINNING in 1935, the Soils and Fertilizers Department of the National Agricultural Research Bureau has been investigating the fertility of the soils of China, with especial reference to the limiting effect of plant food deficiencies, and to the possibility of increasing crop production by the use of fertilizers. The investigation is based in the first place on field experiments, chiefly "NPK Tests" consisting of modern factorial designs at two and/or three levels. The standard rate of application throughout is 8 *catties* per *mou* (about 0.5 cwt./acre), of N, P_2O_5 and K_2O. The experimental crops are rice, wheat, maize, rapeseed, cotton, millet, barley, sugar cane, Irish and sweet potatoes and mulberries (chiefly the first five). The experiments have been carried out either by this department directly, or in cooperation with provincial institutes, universities and other organizations. The field experiments are supplemented by laboratory, chemical tests for "available" nutrients in the soils of the experiments.

The results of over 170 of these field experiments, widely scattered through fourteen provinces of China, are now available. The work is still continuing, and yield results already obtained are still being analyzed, but although the investigation is thus incomplete, it is desired to put the broad results on record, in case the work should be interrupted. It is realized that the number of experiments is not large, in relation to the area covered (a consequence of the difficult conditions which have existed here since 1937), but none the less the general results are quite consistent within the various regions or soil groups, and it is believed that further extension of the work will not greatly alter the picture. It is thought that the findings will have some general interest to agriculturists and geographers, while the implications are important for the future of China.

Eighty-three per cent. of the soils tested in the field experiments gave significant responses to one or more nutrients: in other words, soil fertility is likely to be limited by plant food deficiencies in at least four fifths of the soils of China. (Early statements about the high fertility of Chinese soils were usually based on a superficial acquaintance with the rich soils of alluvial plains and deltas; much of interior China consists of relatively poor, hilly land.) Nitrogen deficiency was most general (74 per cent. of the soils); next came phosphate deficiency (38 per cent.); potash deficiency was uncommon (12 per cent.), probably because of the general use of ashes and local manures. There were clear relationships between the Great Soil Groups (as described by James Thorp), and nutrient supply or deficiency, which there is not space here to set out in detail. Briefly, the pedocal soils of north China (J. Lossing Buck's Wheat Region) were often deficient in nitrogen, but they were generally well supplied with phosphate and potash; the pedalfer soils of central and south China (Buck's Rice Region) were still more deficient in nitrogen, often seriously deficient in phosphate and sometimes deficient in potash. The red and yellow earths were the most seriously nutrient-deficient soil groups, and those on which fertilizers were most strikingly effective in increasing yields.

Estimates were made of the probable extent to which crop production could be increased in China, by using artificial fertilizers in addition to the present

supplies of local manures and fertilizers (which can not be much expanded). If artificial fertilizers were used only on soils where they were likely to be needed (on the soils which gave significant responses in these experiments), it would be possible to increase the total production of crops in China by between one third and one half, using the rates of application mentioned above. (The variability of the estimate depends on the weights to be applied to different crops and regions.) This estimate may be taken as applying to the part of China covered by Buck's "Land Utilization in China," with the exclusion of his Spring Wheat Area. The increase in production would be much greater in the Rice Region (about one half increase over present production) than in the wheat region (about one fifth increase).

Taking economic factors into consideration, and using the 1937 farm prices in east and north China as a basis, it can be said that if all farmers whose soils needed fertilizer applied what was necessary, at the standard rate, then on the average individual farmers would have a two-to-one chance of making a profit (*i.e.*, one farmer out of three would be likely to lose money). If only those farmers applied fertilizer whose soils were likely to give an economic response, on the basis of the field experiments, total crop production in China could still be increased by at least one quarter. Supposing that China developed her own fertilizer industry and that fertilizers could be sold at prices comparable with those in the United States in 1937, then these estimates would be considerably increased. If all farmers with deficient soils used the necessary fertilizers, then each farmer would have at least a five-to-one chance of making a profit from his expenditure; if only those farmers used fertilizers who were likely to secure an economic response, total crop production in China could be increased by at least one third.

The bearing of these results on the population, food and economic problems of China needs no emphasis. While it may not be possible to take much action on them under present conditions, for the future they are equivalent in increased production to adding four or five new provinces to the 17 or 18 provinces for which these estimates may be expected to hold good. In connection with the reclamation and resettlement of the poor soils of southwest China, too, the use of fertilizers is likely often to make the difference between success and failure.

N. F. CHANG
H. L. RICHARDSON

ON THE NATURE OF VIRUS ADAPTATIONS

FILTERABLE viruses are now generally recognized as highly specialized intracellular parasites. They not only are adapted to life within protoplasm, but also show specialized adaptations as to the kinds of cell that they invade and the species of animal in which they produce disease. The several adaptations appear to be distinctive for each individual virus and also to have a range of variation that is characteristic of each virus. Variations of the adaptations, within their ranges, are common in viruses occurring naturally; and by selection of the variations under experimental conditions, modified viruses of different kinds can be produced. Such terms as *neurotropic, dermatotropic* and *epitheliotropic* have been used to designate viruses that have special affinities for certain tissues. The term *pantropic* is used to describe a virus that invades a number of tissues without having a specialized affinity for any one of them.

There seem to be three fundamental adaptations of a virus as a parasite. The primary adaptation is to an existence within living protoplasm. It is this adaptation to growth within protoplasm that I have presented as basic to the transformation of visible microbes into ultramicrobes[1] by the process of retrograde evolution under conditions of parasitism. From the primary adaptation a virus obtains its fundamental characters in relation to a host-cell, such as growth only within the cytoplasm or the nucleus, the production of inclusion bodies before necrosis, the production of necrosis without inclusion bodies and stimulation of the host-cell to proliferation. This adaptation might be termed *cellular adaptation, protoplasmic adaptation* or *cytologic adaptation.* Inasmuch as the study of the cell is known as cytology, the most accurate term for adaptation of a virus to the cell would probably be the last named, *cytologic adaptation.*

Quite distinct is the adaptation of a virus to the type of host-cell[2] in which it grows. An expression of this specialization of a virus is seen in such terms as *neurotropic* and *dermatotropic.* The specialization does not seem to be an adaptation to a tissue or an organ, but specifically to a kind of cell which may, wholly or in part, make up a tissue or an organ. For example, the fox encephalitis virus produces a clinical encephalitis in foxes, but it is not a neurotropic virus, if this term indicates that the virus grows in nerve cells. It grows to the greatest extent in the cerebral vascular endothelium, to a less extent in the hepatic cells and not at all in nerve cells. In general, a virus appears to become adapted to grow best in one kind of specialized cell, but to a less extent it will grow in certain related specialized cells and also in more embryonic types of cell. This second adaptation might be called *organ-* or *tissue-specialization,* but this does not seem satisfactory because a virus grows in types

[1] R. G. Green, SCIENCE, 82: 443–445, 1935.

[2] R. G. Green, "Proceedings of the International Assembly of the Inter-State Postgraduate Medical Association of North America" (October 13–17, 1941, Minneapolis, Minnesota), pp. 80–85. 1941.

of cells regardless of their distribution in organs and tissues. It would seem that *histologic adaptation* best expresses the specialization of a virus with regard to the kind of cell in which it grows, since histology is the science of kinds of cells.

The third type of virus adaptation is related to the species of animal which the virus invades or in which it produces a disease. This adaptation, like the others, appears to be distinctive for each virus. The rabies virus is broadly adapted in this respect, being capable of invading probably all species of mammals and birds. The distemper virus, which is more restricted, produces a disease only in members of the weasel family, the raccoons and the Canidae. The virus of the oral papillomatosis of dogs appears to be capable of invading only the dog. The adaptation to growth in a host-species or in a range of host-species might well be termed the *zoologic adaptation* of a virus.

While the cytologic adaptation of a virus seems to undergo little or no variation, the histologic and the zoologic adaptations seem to be subject to extensive natural variation. Within the ranges of the latter two adaptations, great experimental change can be effected in a virus by the selection of the species of animal injected and by the choice of tissue used as virus in serial host-to-host transfers. The distemper virus may be highly adapted to ferrets by host-to-host passage, becoming highly virulent for that animal and at the same time becoming a harmless, immunizing agent for members of the canine family. Distinctly different, artificially modified distemper viruses are produced by ferret-passage, depending upon whether the virus is passed serially through ferrets by subcutaneous injection and the use of spleen as inoculum; by intracranial injection and the use of brain tissue as transmission material; or whether it is passed by skin-to-skin inoculation. Such viruses are identical in their zoologic adaptation but differ in their histologic adaptation. A clear separation of these adaptations seems essential to qualify the nature of both natural and experimental viruses.

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URETHANE: ABSENCE OF PARALLELISM WITH THE ANTI-SULFONAMIDE ACTION OF p-AMINOBENZOIC ACID

THE demonstration by Johnson[1] that urethane (ethyl carbamate) exerts an anti-sulfanilamide effect on systems involving luminous bacteria led to the assumption that urethane should exert an anti-sulfonamide action by inhibiting the *in vivo* protective action of sulfonamides against streptococcal or other infections. That this assumption is not correct has been demonstrated in this laboratory.

p-Aminobenzoic acid (0.5 grams per kilo) completely inhibits the protective action of sulfanilamide (2.0 grams per kilogram) against a streptococcus infection (produced by the injection of 0.1 cc of a 24-hour broth culture of Strep. hemolyticus). Urethane (0.5 grams per kilogram) fails to inhibit the anti-streptococcal action of sulfanilamide (2.0 grams per kilogram). Approximately 500 mice were used to establish this point.

The failure to demonstrate an anti-sulfanilamide action by urethane in an *in vivo* system involving protection against streptococcus infections limits the applicability of data obtained from the study of luciferase systems to the broader aspects of sulfonamide action. The basic mechanisms involved in the luciferase system are not necessarily those involved in the anti-bacterial action of sulfonamides generally.

GUSTAV J. MARTIN
C. VIRGINIA FISHER
WARNER INSTITUTE FOR THERAPEUTIC RESEARCH,
NEW YORK, N. Y.

[1] SCIENCE, 95: 104, 1942.

BLUEBERRY STORAGE

DURING 1941 the Maine Agricultural Experiment Station conducted blueberry storage studies under controlled atmosphere and controlled temperature. These studies showed a great variation in the keeping quality of the different clones of low-bush blueberries and varieties of high-bush blueberries. The low-bush showed the greatest variation, as some of the clones with poor flavor when they were put in storage had good flavor when the storage period was completed. With other clones the reverse was observed. The fully mature and overripe berries did not keep well in storage and while they appeared good when removed from storage they became soft and wet before the berries could be retailed. In these experiments, the named varieties of high-bush blueberries did not store as well as some of the high-bush selections made in Maine.

The blueberries which were stored at 5° C and in an atmosphere with an oxygen content of 5 per cent. or slightly less were in the best condition at the end of the experiment. Carbon dioxide contents of from 13 to 15 per cent. in the atmosphere were not detrimental in these studies. These conditions are similar to those used by Van Doren *et al.*[1] in the storage of cherries, and the temperature was slightly higher than that recommended by Levine *et al.*[2] for the storage of

[1] A. Van Doren, M. B. Hoffman and R. M. Smock, *Proc. Amer. Soc. Hort. Sci.*, 38: 231–238, 1941.
[2] A. S. Levine, C. R. Fellers and C. I. Gunness, *Proc. Amer. Soc. Hort. Sci.*, 38: 239–242, 1941.

cranberries. Commercially, blueberries may be kept for 2 to 4 weeks or from the middle of August to the first of September. For home use blueberries were stored for several months in sealed glass jars placed in the home refrigerator. The temperature in the home refrigerator was above the optimum for storage, but a very satisfactory result was obtained. The author enjoyed a delicious pie made from berries that had been kept in the home refrigerator for six months.

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SCIENTIFIC BOOKS

OVERFISHING

The Overfishing Problem. By E. S. RUSSELL, Director of Fishery Investigations, Ministry of Agriculture and Fisheries, Great Britain. 130 pp. Cambridge Press, 1942. New York: The Macmillan Company.

SELDOM does one find so clear and understandable, so forthright and unpretentious and so readable and entertaining a condensation of more than a half a century of scientific research as is found in Dr. Russell's little book embodying the De Lamar lectures delivered before the School of Hygiene of the Johns Hopkins University in March, 1939; nor could one conceive of a subject of greater importance to the fisheries of the United States with their potential six-billion-pound yield of war-time food than "the overfishing problem" which is the subject of these lectures.

Although the specific illustrations and the supporting scientific data were drawn chiefly from the fisheries of Great Britain, in the North Sea and from the Arctic Coast of Norway and Iceland, to the Atlantic shelf of Africa, the general principles which control anywhere in the world the development, the rise to maximum production and the ultimate decline of sea fisheries under intensive exploitation are clearly defined in such a way that the American reader will find frequent application to familiar conditions in home waters. Each of the lectures—(1) the exploitation of the fish stocks, (2) the depletion of the older grounds, (3) age analysis of fish populations, mortality rates and rate of growth, (4) the overfishing problem in its modern formulation, and (5) the regulation of the sea fisheries—is complete in itself and affords a leisurely hour's reading. Such a reading, however, will provoke many hours of thoughtful reflection, and such reflection should lead to profitable action on the part of American fishery interests.

In his conclusion, Dr. Russell says:

> We have seen in the course of these lectures that the state of overfishing exists in many of the trawl fisheries in Northwestern European waters. Two things are wrong. First, there is too much fishing, resulting in catches below the possible steady maximum, and second, the incidence of fishing falls too early in the fishes' life, resulting in a great destruction of undersized fish which ought to be left in the sea to grow. Mesh regulations, if sufficiently drastic, will cure the second evil so far as round fish are concerned, and they may well be reinforced by suitable size limits. For the first evil, there is only one radical cure, namely a reduction of the amount of fishing.

This is a familiar theme to fishery biologists in the United States who have reached identical conclusions from extensive data gathered over a period of years by the old Bureau of Fisheries and the present Fish and Wildlife Service. It is on the basis of such research that Herrington has recommended increased mesh sizes and minimum size limits for the New England trawl fisheries, and minimum size limits for lobsters; restrictions on the intensity of fishing have been recommended by Dahlgren for the Alaska herring and by Nesbit for the Atlantic shad and other shore species. The latter recommendation is based on a fundamental principle which Dr. Russell fully develops: ". . . that up to a point you can increase yield by increasing fishing, but after this maximum is reached the more you fish the less weight of fish you catch." From a series of simple theoretical calculations and from a great number of practical illustrations taken from many years' records of the British fisheries, he draws the general conclusion "that there must be for every fish an optimum rate of fishing. When the rate exceeds the optimum the yield will fall in spite of the increased effort expended."

Dr. Russell cites a well-known example of the benefits of a reduced fishing rate in the Northern Pacific halibut fishery in which legal control of the rate of fishing has been applied under the treaties made between the United States and Canada in 1924 and 1930, renewed in 1937. He recalls to us the fact that the formerly depleted halibut fishery was restored under regulation. On the southern banks the abundance of halibut increased by as much as 60 per cent. So great was the general increase in the stock that the fishermen are able to catch their limit in five months instead of in nine and the commission now estimates that the earnings of halibut fishermen are $1,000,000 a year greater than they would have been without regulation.

To an American fishery biologist the book is most refreshing not because the facts are new—they have all been published in the technical literature—nor because the conclusions and the plan of action for restoring the fisheries of Northwestern Europe are unique but because they parallel so closely the conditions revealed by fishery research in American waters and because the correctives for overfishing in Europe are the same as those that must be applied here. Indeed, Dr. Russell's conclusions have universal application and, although the method of applying them will vary for different species and in different localities, it is for this reason that the book merits thoughtful reading by American fishery administrators, operators and fishermen.

The American scientist also may well find the book a fascinating introduction to a distinct and rapidly developing field of science with which he is, by and large, quite unfamiliar. The late great Dr. Raymond Pearl recognized the affinities of fishery biology with the particular field of human biology in which he had labored so effectively. It is to him that the handful of us are so greatly indebted for the privilege of becoming acquainted with the rugged integrity and the kindly, homespun personality of Dr. Russell—a man honored at home with the Order of the British Empire for outstanding scientific work in a field so "lowly" as the fisheries.

ELMER HIGGINS

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WASHINGTON, D. C.

SOCIETIES AND MEETINGS

THE WISCONSIN ACADEMY OF SCIENCE

THE annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held at the University of Wisconsin, on Friday and Saturday, April 17 and 18. Forty-one papers were presented by members and guests of the academy, while 32 papers were read in sessions of three societies which met jointly this year with the academy—the Wisconsin Archeological Society, the Wisconsin Museums Conference and the Wisconsin Folklore Society.

Dean of speakers on the academy program was the 91-year-old ex-president of the University of Wisconsin, Edward Asahel Birge. Mr. Birge has been a member of the Wisconsin Academy since 1876, six years after the founding of the academy by act of the Wisconsin Legislature in 1870. During this period Mr. Birge has been one of the most regular of attendants at academy meetings, and has published many limnological articles in the *Transactions*. Mr. Birge delivered a paper entitled "The Relations between Water and Transmitted Sunlight."

Papers dealing with a wide variety of subjects were presented by academy members from Wisconsin colleges and universities, as well as by members from outside of Wisconsin. Two programs of correlated papers were arranged by Professors Lowell E. Noland and Arthur D. Hasler, both of the zoology department of the University of Wisconsin. The first-named group included several papers on the fresh-water clam, *sphaerium*, and the snail *Lymnaea stagnalis*. Professor Hasler's group of papers included a series of studies of Lake Geneva, Wisconsin, where in the summer he is the director of the Lake Geneva Institute of Natural Science.

Officers elected for 1942–1943 are as follows: A. W. Schorger, Madison, *President;* W. N. Steil, Milwaukee, *Vice-president in Sciences;* Ralph Buckstaff, Oshkosh, *Vice-president in Arts;* Berenice Cooper, Superior, *Vice-president in Letters;* Loyal Durand, Jr., Madison, *Secretary-Treasurer.* The secretary is also editor of the *Transactions,* a new number of which is being started to press. Award of the research grant from the American Association for the Advancement of Science was made to Professor James F. Groves, of Ripon College.

LOYAL DURAND, JR.,
Secretary

NORTH CAROLINA ACADEMY OF SCIENCE

THE forty-first annual meeting of the North Carolina Academy of Science was held at the Woman's College of the University of North Carolina, Greensboro, on April 24 and 25. Despite emergency curtailment of tires and gas and despite the fact that many of our members are directly engaged in war work, the meeting was well attended. About 300 scientists heard a varied program of some 70 papers. The North Carolina Section of the American Chemical Society met at the same time and place with 9 papers on their program.

A new section dealing with the problems of wildlife conservation and management was organized this year. The program of 10 papers was heard by a large group, and considerable discussion followed each paper. This appears to be a very desirable section, which promises to grow in interest, and one which may operate to the profit of all who are interested in making the most of our wildlife.

In addition to the usual sectional program of formal papers the psychologists held a panel discussion on

"The Psychological Aspects of Morale." The meeting was well attended and evoked considerable interest and discussion.

The Poteat Award was conferred on J. P. Decker, of Duke University, for his paper on "The Effect of Temperature on Photosynthesis in Red and Loblolly Pines." The High School award of $20 went to Ernest Hardwick and Arthur Budlong, of the Winston-Salem High School. They demonstrated a home-made stroboscope.

After a complimentary dinner given by the Woman's College, Dean Jackson in his address of welcome lauded two former academy members, also former teachers at Greensboro, for their achievement in the scientific world. They were Gilbert T. Pierson and E. W. Gudger. Dr. R. E. Coker then delivered the presidential address, taking as his subject, "What Are the Fittest?" The address was a zoologist's view of the present world conditions. After the address an informal open house gave opportunity for renewing old friendships and establishing new ones. During this time the group experienced its first blackout.

Committee reports were made in mimeographed form, and these along with the treasurer's preliminary report were adopted. The secretary reported the election of about 50 new members. This makes a total of more than 225 new members elected in the last three-year period.

The following officers were elected: *President,* H. F. Prytherch, of the Bureau of Fisheries; *Vice-president,* Eva G. Campbell, of Guilford College; *Secretary-Treasurer,* Bert Cunningham (re-elected for a three-year term), of Duke University; *New Member of the Executive Committee,* O. J. Thies, of Davidson College; *New Member of the Research Grants Committee,* J. P. Givler, of the Woman's College.

A more detailed report of the meeting will appear in the *Journal* of the Elisha Mitchell Scientific Society.

BERT CUNNINGHAM,
Secretary

SPECIAL ARTICLES

THE RELATION OF URINARY CITRIC ACID EXCRETION TO THE MENSTRUAL CYCLE AND THE STEROIDAL REPRODUCTIVE HORMONES

THE role of citric acid in mammalian metabolism still remains obscure. Some of the prevailing theories and factual observations relating to this metabolite may be reviewed briefly. It is present in small amounts in the tissues and body fluids, and is a constant urinary constituent, (0.2–1.2 gms/24 hrs. in man.) It is evidently a product of endogenous metabolism, since it continues to appear in the urine during starvation, and the amounts excreted under normal conditions are greatly in excess of those present in the food or stored in the tissues.[1] Krebs, as a result of studies on minced tissues,[2] has assigned to it an important role in carbohydrate oxidation, but his theory still awaits support from work on intact tissue. In the living organism, citric acid has been shown to enter the carbohydrate cycle, but in a manner not implicit in the citric acid cycle postulated by Krebs. It exerts an anti-ketogenic effect and overcomes insulin hypoglycemia.[3] It is converted almost quantitatively to glucose in the phlorhizinized dog, and deposited as liver glycogen when fed to normal rats.[4,5] It has also been found to be related to acid-base regulation. Alkalosis, however induced, leads to an increase in urinary citric acid, excretion generally varying directly with urinary pH.[6] Finally, the unusually high citrate content of bone[7] is suggestive of some connection with calcium metabolism. The present paper links citric acid to still another physiological process, the menstrual cycle.

We wish to report experiments with human subjects which have revealed a relation between citric acid excretion and the steroidal reproductive hormones. These experiments were carried out on five young women with regular menstrual cycles, two young women with amenorrhea, and one hypogonadal male. Except in the case of two female subjects, both laboratory workers, the studies were carried out in the Metabolism Ward of the Department of Medicine in order to insure accurate urinary collections and proper dietary control. Citric acid was determined by a modification of the pentabromacetone method.

Analysis of the daily urinary excretion of citric acid during six complete menstrual cycles of the five subjects studied, showed, in all cases, a characteristic cyclic alteration in the level of the citric-acid content during the different phases of the menstrual cycle. The lowest levels always occurred during menstruation, the highest, at about the middle of the cycle. The shape of the curve varied with the different subjects, both with respect to the rapidity and height of the midmenstrual rise, and the duration of the increased excretion. In one patient studied over two

[1] C. C. Sherman, L. B. Mendel and A. H. Smith, *J. B. C.,* 113: 247, 1936.
[2] H. A. Krebs and W. A. Johnson, *Enzymologia,* 4: 148, 1937.
[3] E. M. MacKay, H. O. Carne and A. N. Wick, *J. B. C.,* 133: 59, 1940.
[4] I. Greenwald, *J. B. C.,* 18: 115, 1914.
[5] C. A. Kuether and A. H. Smith, *J. B. C.,* 137: 647, 1941.
[6] O. Östberg, *Skand. Arch. Physiol.,* 62: 81, 1931.
[7] F. Dickens, *Biochem. Jour.,* 35: 1011, 1941.

consecutive cycles, the shapes of the excretion curves were similar in both cycles. In four cycles, a brief, but significant, fall in excretion occurred midmenstrually and lasted for one or two days. In four cycles, the higher level of citric acid excretion persisted during most of the second half of the cycle, to fall abruptly two or three days before the next flow. The maximal midmenstrual increases in citric acid excretion over the menstrual levels were 225, 240, 275, 350, 450 and 500 mgs for the six cycles studied.

The accompanying graph (Fig. 1) illustrates the

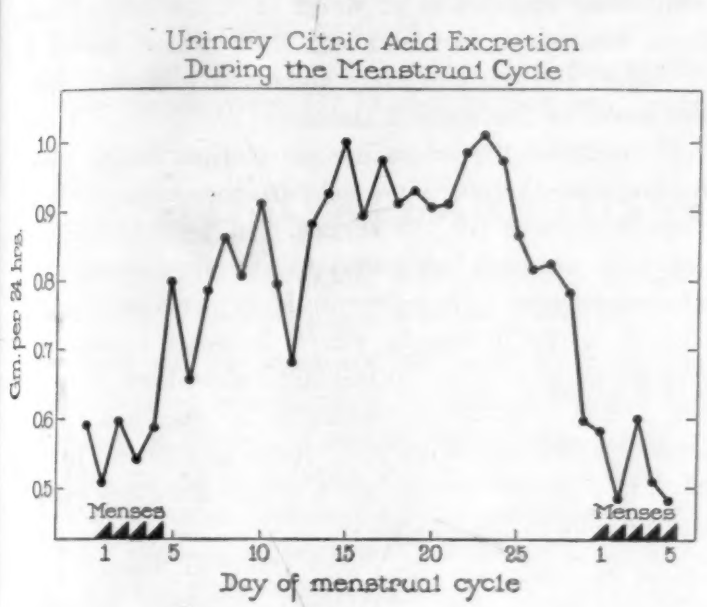

FIG. 1.

characteristics of the curve of citric acid excretion during the menstrual cycle of one of the subjects. The post-menstrual rise, the sharp midmenstrual dip, the persistence of the high level of excretion during most of the premenstrum, and the abrupt fall to the previous menstrual levels, were particularly striking in this subject.

Results, of a preliminary character, can be reported of experiments designed to analyze the relation of the individual steroidal reproductive hormones to the cyclic alterations in citric acid excretion during the menstrual cycle. An estrogenic hormone, (estradiol benzoate), was administered to two amenorrheic girls in amounts that did not exceed their estrous requirements, as judged by vaginal smears. Both subjects showed significant increases in citric acid excretion (230 and 500 mgs, respectively), during its administration, and a sharp return to lower levels on cessation of treatment. We are now investigating the possible influence of progesterone on citric acid excretion, in view of the fact that the high level of excretion is generally maintained throughout most of the second half of the cycle. The reverse effect on citric acid excretion was observed when an androgen, testosterone, was administered to a male with pituitary hypogonadism. During two courses of treatment, urinary citric acid fell significantly, (300 mgs/24 hrs.), below the control values and rose sharply to previous levels when treatment was terminated. In one amenorrheic girl, testosterone propionate likewise reduced the daily output of citric acid by 175 mgs. Additional studies on human subjects and animals are under way to ascertain the constancy and prevalence of these phenomena.

The studies on the female subjects were correlated with vaginal smears. The results of the correlation of this index of ovarian function with the excretion of citric acid will be reserved for a subsequent report.

These observations would appear to establish the existence of a cycle of citric acid excretion which bears a definite relation to the menstrual cycle and is probably hormonally conditioned. This cycle may result from a direct effect of the hormones involved on citric acid metabolism, or from their influence on some other mechanism, such as acid-base regulation, renal function or carbohydrate metabolism, which in turn influences citric acid formation and excretion. Since citric acid is but one of the organic acids eliminated in the urine, it will be necessary to determine whether or not excretion of other organic acids is also altered under these conditions, before the changes in citric acid excretion can be regarded as specific. The bearing of these results on all previous experiments dealing with citric acid excretion in women is obvious.

Although these experiments throw no new light on the basic problem of the endogenous metabolism of citric acid, they do point out a new functional relationship, and should provide a valuable tool to aid in its study.

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PHYSIOLOGIC STUDIES ON THE CORNEA

THE cornea is a composite membrane forming the anterior portion of the outer coat of the eye-ball. In all vertebrates it has on its anterior surface a thin, stratified epithelial layer and on its posterior surface a single layer of endothelial cells. Just anterior to the endothelium is a homogeneous elastic lamina (Descemet's membrane), and just beneath the epithelium there is, in some species, a homogeneous glass-like lamina (Bowman's membrane). The remainder of the cornea, the substantia propria, comprising about 90 per cent. of its total thickness, is made up of collagenous fibers and supporting cells arranged parallel to the surfaces of the cornea. These fibers

merge into those of the sclera without any abrupt histologic transition corresponding to the change from the transparent to the opaque portion of the corneo-scleral coat.

The permeability, the degree of hydration, the transparency and the absence of blood vessels are four properties which distinguish the cornea from the sclera, and indeed from most other tissues. These properties have been extensively studied in this laboratory during the past two years and, as a result of the new findings, especially as regards permeability, have led to a new concept of corneal physiology. The data are to be reported in detail elsewhere.[1] A preliminary report of some of the findings and conclusions which are of general interest are presented here.

The excised cornea was found to be, in effect, impermeable in either direction to NaCl but freely permeable in both directions to H_2O. Removal of the epithelium caused the cornea to become permeable to NaCl, from which it was concluded that the epithelium was an effective semipermeable membrane with respect to NaCl. The permeability of the endothelium could not be adequately studied with the excised cornea because of damage resulting from the manipulation. But if the corneal epithelium is first removed the properties of the endothelium may be studied in the intact eye. In this manner it was shown that the endothelium is substantially like the epithelium in being an effective semipermeable membrane with respect to NaCl. Thus the substantia propria, while permeable to NaCl and water, is bounded on either side by membranes permeable only to water.

The normal degree of corneal hydration appears to be quite unusual, for when pieces of cornea are immersed in various aqueous solutions they swell several hundred per cent. This was found to be true, even though the bath fluid was blood serum or aqueous humor and despite wide variations in hydrogen ion concentration or in tonicity of the solutions. The only way in which the explanted cornea could be maintained in a state of dehydration comparable to that existing normally was by maintaining an osmotic gradient across the intact epithelium or endothelium, or both, so that water was abstracted from the cornea as rapidly as it became available in the stroma. Presumably a similar mechanism is operative *in vivo;* fluid diffuses into the cornea from the vascular plexus at the corneo-scleral junction, and its water is continuously transferred into the hypertonic tears on the anterior surface and into the hypertonic aqueous on the posterior surface.

The maintenance of corneal dehydration is essential for transparency. Removal of the semipermeable membranes or lowering the tonicity of the bath fluids will allow the cornea to swell and become opaque. Presumably the interstitial fluid, having a different refractive index from that of the structural components of the cornea, must be removed or prevented from accumulating in order to maintain optical homogeneity.

Correlated with the dehydrating mechanism as described above is the effect on circulation. The cornea has no vascular or lymphatic vessels, and nutritive material is provided by diffusion from the periphery. It now seems likely that, in addition to diffusion, the continuous abstraction of water from the corneal surfaces ensures a movement of fluid which serves to transport oxygen and other dissolved materials from the blood to the corneal tissues.

By contrast the sclera has no semipermeable membranes and therefore no dehydrating mechanism as described above for the cornea. In consequence, the sclera is normally hydrated to its physiologic limit and is opaque. If, however, it is artificially dehydrated, as by drying in air, it becomes transparent like the cornea. The optical difference, then, between the cornea and sclera appears to be due, not to any structural difference in their respective fibers, but to the fact that the former has a dehydrating mechanism not present in the latter.

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[1] *Archives of Ophthalmology.*

PHYSIOLOGICAL ACTIVITY OF ASCORBIC ACID IN PLANT LIFE

THE diurnal variation of ascorbic acid in tomato plants previously noted,[1] if common to all plants, merits further consideration in determining the best time to harvest edible greens. If greens are to be shipped or canned, is it preferable to cut them in the evening or in the morning? Using young tomato plants grown in pots as subject material, a number of pertinent experiments have been made.

The plants to be allowed to grow overnight were washed free of soil gently to avoid root injury; adhering water was blotted off with absorbent paper; the plants were weighed and at once replanted. Such repotted plants gained very little in weight overnight even though the pots were standing in water to cover the soil, whereas cut plants standing in water always gained appreciably.

Knowing the change in weights of the plants held overnight, both cut and growing, it was possible to calculate the ascorbic acid content in the morning back to the weight of the previous evening and thus eliminate the dilution effect. Typical results are given

[1] SCIENCE, December 13, 1940, p. 561.

in Table 1, the morning ascorbic acid values calculated back to the weight of the plants in the evening. The

TABLE 1

ASCORBIC ACID VALUES—MG PER CENT

	Expt. 1	Expt. 2	Expt. 3
Evening (4–5 P.M.)	62.8	52.0	46.3
Next morning—cut plants (8–9 A.M.)	47.7 (15)	32.9 (18)	22.5 (12)
Next morning—uncut plants (8–9 A.M.)	31.5 (0)	27.8 (3.5)	18.2 (2)

figures in parentheses represent the per cent. increase in weight of the plants overnight.

From these data it appears that the cut plants retained, respectively, 51, 18 and 24 per cent. more ascorbic acid than the growing plants in the three experiments; even though the cut plants gained 10 to 15 per cent. more in weight, their percentage of ascorbic acid was, respectively, 34, 7 and 10 per cent. higher than uncut plants in the three experiments.

The data indicate that the losses in ascorbic acid noted in vegetables and fruits in storage are not due entirely to oxidation by atmospheric oxygen, as is often stated, but due to its being used in some physiological process, the activity of which is diminished by severing the plant from the root system.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN EGG INOCULATOR AND SHELL MEMBRANE TEASER FOR VIRUS CULTURE

IN view of the extensive use now made of the chorio-allantoic membrane of chick embryos for the cultivation of viruses, it seemed desirable to simplify the technique of inoculation and at the same time, if possible, decrease the losses due to accidental injury of the membrane. The egg inoculator, shown in Fig. 1, satisfies these requirements.

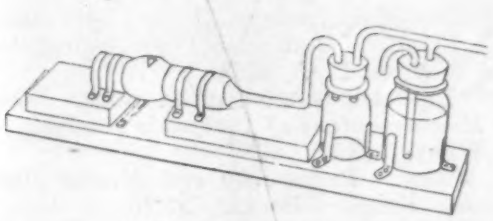

FIG. 1. Egg inoculator.

A triangular window is cut in the shell in the usual manner and a hole drilled into the air sac. The egg is then placed between the two rubber rings of the inoculator. The one which grasps the pointed end of the egg is mounted on a movable base actuated by springs which force the rings together. The other ring forms a tight junction with the egg and is connected with a suction device. A simple by-pass prevents the suction from becoming great enough to cause damage. When the suction exceeds the hydrostatic pressure of 5 centimeters of water, air passes down the tube and bubbles up into the system, maintaining the negative pressure at a constant level. The air sac and through it the interior of the egg is, in this way, subjected to a continuous negative pressure while the fragment of shell is being removed and the slit made in the shell membrane.

Instead of a needle for making the slit in the membrane, a shell membrane teaser is used. This is easily formed from a single limb of a pair of curved forceps. The tip is bent backwards in such a way that when the instrument is applied vertically to the shell membrane, and then drawn sideways, the serrations catch the fibers of the membrane. The lateral traction causes a tear in the membrane at a slight distance from the teaser. The location of the slit, together with the fact that the constant suction causes the chorio-allantois to drop the instant the slightest tear forms in the shell membrane, combine to prevent injury by the instrument to the chorio-allantois. The egg is now ready for inoculation in the usual manner.

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A QUANTITATIVE VAPORIZER

AIR disinfection depends upon quantitative dosage control. Vaporization of chemical disinfectant may be quantitatively controlled by regulation of heat applied. In non-conducting fluids resistance coils can be submerged directly into the liquid and, since heat loss from the walls of a vessel at constant temperature (near boiling point of the fluid) is uniform, the excess heat absorbed in vaporization can be regulated by the amount of current supplied to the coil.

The sketch shows a simple U tube with a short length of heating element immersed in propylene glycol used in experimental study of chemical disinfection of air. To prevent uncovered resistance wire from reaching ignition point, copper leads transmit the current through the liquid to the coil. The air stream passing over the surface of the liquid carries the vapor into the dosing chambers.

An ordinary heating element submerged in a beaker of propylene glycol will evaporate upwards of a gram per minute. Care should be taken not to allow resis-

tance wire carrying current to emerge from liquid surface, and to insure against this possibility it may be desirable to provide a constant level device. Other

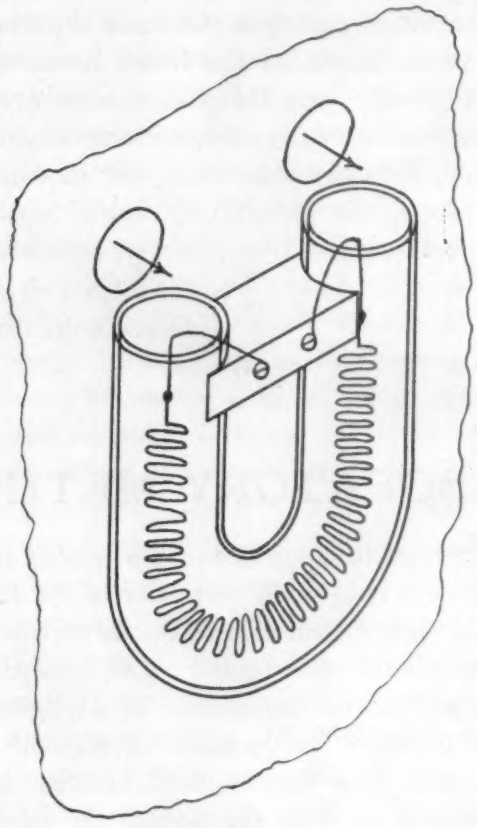

FIG. 1.

adaptations may provide convenient means of vaporizing propylene glycol or other non-conducting fluids in experimental air disinfection.

W. F. WELLS

LABORATORIES FOR THE STUDY OF AIR-BORNE INFECTION,[1] UNIVERSITY OF PENNSYLVANIA SCHOOL OF MEDICINE

HEAT INACTIVATION OF WHEAT MOSAIC VIRUS IN SOILS

WHEAT mosaic virus *Marmor tritici* H.[1] is of interest not only because of the economic losses induced in winter wheat in certain wheat-growing areas of the Midwest, but also because it may be directly transmitted from the soil. Previous studies[2, 3, 4] on the relationship between soil and virus suggested an investigation to determine the resistance of the virus in the soil to heat. Virus-infested soil at optimum moisture content was passed through a screen of ¼-inch mesh, placed in stoppered test-tubes 3 cm by 20½ cm in size and tamped lightly. Twenty-five soil samples contained in these tubes were heated at each of the temperatures: 40°, 50°, 60°, 70° and 80° C. A thermometer was inserted into the center of one tube in each series of tests and the samples immersed in an electrically heated and thermostatically controlled water bath. The tubes were spaced and the water forced to circulate freely between them by means of an electric stirrer. After the soil had reached the desired temperature in the tube containing the thermometer, a 10-minute exposure was given, after which the tubes were removed and immediately cooled in running tap water. The soil was then emptied into No. 10 tin cans. Wheat seeds of variety Purdue No. 1 were planted in the treated soil and the young plants kept outdoors over winter. After dormancy was broken it was found that all wheat plants grown in soil heated at 40° and 50° C were affected with mosaic, while all plants in the remaining series were healthy. These results indicate that wheat mosaic virus is inactivated in the soil between 50° and 60° C at an exposure of 10 minutes.

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[1] These laboratories are supported by a grant from the Commonwealth Fund to the University of Pennsylvania for studies in the prevention and control of air-borne infection.

[1] F. O. Holmes, "Handbook of Phytopathogenic Viruses." Minneapolis, Minn.: Burgess Publishing Company.

[2] H. H. McKinney, U. S. Dept. of Agr. Bull. 1361, 1925.

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[4] R. W. Webb, *Jour. Agr. Res.*, 36: 53–75, 1928.

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TENNENT, DAVID HILT. *The Photodynamic Action of Dyes on the Eggs of the Sea Urchin, Lytechinus Variegatus.* Pp. 153. 40 figures. 8 plates. Carnegie Institution of Washington. Paper, $1.25. Cloth, $1.75.

SCIENCE NEWS

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MEDICAL MEETINGS AT ATLANTIC CITY

HIGH blood pressure, one of the unsolved medical problems, is more common in women but more serious in men, according to a report by Dr. R. L. King, Dr. Thomas Carlile and Dr. J. M. Blackford, of the Mason Clinic, Seattle, to the American Heart Association meeting in Atlantic City. Among 794 patients found to have high blood pressure in general examinations given between 1924 and 1930, the women predominated in a ratio of 3: 2. However, twice as many women as men were living 10 to 16 years later. Of the total group followed up 10 to 16 years later, 128, or a little over one fourth, were still living, with 353 dead. Fourteen lived 15 years or longer after their high blood pressure was first noted. Heart failure caused twice as many deaths in this group as any other single cause. Heart enlargement may occur in high blood pressure patients in a relatively short time. This depends for the most part on how high the blood pressure is and how long it remains high. The influence of high blood pressure on the expectation of life is "striking," they said. Men 40 to 45 years old, with a life expectancy normally of about another 25 years, lived only about five years longer. The seriousness of the outlook for high blood pressure patients is, in general, influenced by the height of the blood pressure, advancing age, and the presence of signs of progressing changes in the blood vessels, especially in the brain, heart and kidneys.

Cause of the undue fatigue, shortness of breath, dizziness, fainting and even distress or pain around the heart in patients with varicose veins of the legs is the pooling of the blood in the varicose veins, was announced by Dr. Earle M. Chapman and Dr. Erling Asmussen, of Massachusetts General Hospital and the Harvard Fatigue Laboratory, at the meeting of the American Heart Association. "In the aged and in those with known heart disease, the added burden from varicose veins may be enough to provoke severe symptoms." Wearing elastic stockings or an operation to cut off the blood supply to the varicose veins relieves the symptoms. The reason why the cause for the symptoms had not previously been recognized may have been because the symptoms usually are moderate in nature and seldom lead to actual heart failure. The problem was investigated after the examination of a patient who was thought to have angina pectoris or some other kind of serious heart trouble. Careful examination disclosed no sign of heart disease, but when the patient got off the examining table one of the doctors noticed the large varicose veins in her legs enlarging as they filled with blood. He suddenly had the idea that the pooling of the blood in these veins might have caused such a decrease in the amount of blood returned to the heart by the veins that there was a deficiency in blood flowing through the heart's own artery which would cause heart pain. This patient obtained relief by wearing elastic stockings on both legs. Investigation then revealed that almost a fifth of the patients with varicose veins, 47 out of 250, complained of undue shortness of breath that was relieved when they lay down. Studies of blood circulation in normal persons and those with varicose veins when changing from recumbent to standing posture confirmed the idea that the pooling of the blood in the varicose veins could interfere with the circulation enough to cause the heart pain and other symptoms.

Fever artificially induced by certain chemicals or by triple typhoid vaccine will significantly reduce blood pressure, particularly in patients suffering with high blood pressure, according to Dr. Herbert Chasis, Dr. William Goldring and Dr. Homer W. Smith, of New York University College of Medicine. Repeated doses of the fever-inducing substance will keep the blood pressure at lower levels, even when the fever itself is kept from developing by first giving amidopyrin. The treatment, however, cannot be called a "cure" since it does not correct the fundamental process that causes the high blood pressure. The substances used besides the triple typhoid vaccine were a kind of sugar called inulin and tyrosinase, the enzyme that blackens potatoes which had previously been reported as a blood pressure reducing chemical. None of these caused any harm so far as could be observed, but they must be used cautiously. This was shown by the alarming experience with one patient whose blood circulation was slowed down so far that she became unconscious following treatment with the triple typhoid vaccine. The blood pressure lowering effect of the fever-inducing substances is believed to be the result of an "adverse" reaction of weakness on the part of the heart and blood vessels. The practical value of the results of the treatment was not the discovery of a new remedy for high blood pressure, but the new light thrown on the action of other remedies that might at first seem to be effective in treatment of this condition. They may owe their apparent effectiveness as high blood pressure remedies, it now appears, to the fact that they are contaminated with common bacteria related to the typhoid fever group of germs. These germs and substances from them may cause fever and may also reduce blood pressure. The chances for blood pressure reducing remedies becoming contaminated with these germs are plentiful. It is pointed out that such contamination must be ruled out before the remedies themselves can be credited with reducing blood pressure.

Scleroderma, the strange hidebound condition of the skin sometimes seen in "the man who turned to stone" of the circus side shows, is a disease affecting the entire body and not just the skin, was reported by Dr. A. Wilbur Duryee and Dr. Irving Leinwand, of New York Post-Graduate Medical School, Columbia University, to members of the American Heart Association and the American Therapeutic Society. Brain wave records, the first ever taken on such patients, showed abnormal tracings in a high percentage of cases. It is possible these reflect injury or disease of the blood vessels of the brain, although no definite conclusions on this point can be made yet.

The trouble begins with the blood vessels, and not with the skin, in the opinion of the authors. The outlook in scleroderma is more serious than is usually believed. No specific treatment has yet been discovered. Thyroid and female sex hormone extracts, vitamins C and B, and mecholyl iontophoresis to increase blood flow to the affected parts of the skin are preferred methods of treatment. All possible factors that could cause inflammation of the arteries or spasm of the blood vessels, such as heavy metals, arsenic, tobacco, ergot and allergens of various kinds and mechanical injury, should be eliminated if possible.

More sneezes and other trouble for hay fever sufferers this summer is expected by Dr. O. C. Durham, chief botanist of the Abbott Laboratories, North Chicago. He warned members of the American Association for the Study of Allergy to be on guard against new sneeze trouble from the pernicious weed known as Mexican fireweed, burning bush, fireball, firebush and summer cyprus. The weed is now rampant in Iowa, Nebraska, and Colorado and is threatening adjacent states. It has been found as far east as Detroit and as far south as St. Louis. For many years small colonies have been found from time to time along the Atlantic coast. It did not come from Mexico, in spite of one of its aliases, but from southern Europe or Asia. It may have got its start as a weed pest by reversion from a cultivated variety commonly used as a decorative plant under the name summer cyprus. The botanical name for the weed is *Kochia scoparia*. The acreage of the weeds in the newly infested areas so far is more impressive than the output of pollen, but it takes only a small amount of the pollen to cause a great deal of suffering. This weed may drive out some of the ragweed which causes so much hay fever, but, says Dr. Durham, even if it "should succeed in replacing as much as half of the acreage of ragweed in the farming area of the Mississippi Valley, the reduction of the ragweed content of the air could probably hardly be noticed by ragweed sufferers. An appreciable volume of a new and unrelated air-borne allergen in that area would certainly complicate a difficult situation."

Prospective brides and grooms of the future may have their brain waves studied before marriage to rule out epilepsy in their offspring just as many now are required by law to have pre-marital blood tests for detection of unsuspected syphilis. This possibility appears in a report by Dr. William G. Lennox, of Boston, to the American Medical Association. "Epilepsy is not inherited but a predisposition to epilepsy may be inherited. The predisposition may possibly be evidenced by a hereditary cortical dysrhythmia (disturbed rhythm of the gray matter of the brain). The problem of epilepsy and related disorders is the personal concern not merely of the half million persons who are subject to seizures, but of the 10,000,000 or 15,000,000 persons who have abnormal patterns of brain wave activity. This means that questions of marriage and children apply not only to persons with seizures, but to this very much larger group who may be capable of transmitting the dysrhythmia and the predisposition." Physicians may be able to give specific instead of generalized advice to epileptics and their relatives about marriage and children, taking into account the brain wave record of the supposedly normal marriage partner and other valuable and inheritable traits which may outweigh the presumably undesirable trait of abnormal brain waves. Abnormal brain wave rhythm, Dr. Lennox stated, "is not a fixed trait but may be modified and perhaps corrected by chemical means. This possibility is enhanced by the beneficial effects observed from the use of the non-sedative drug, phenytoin sodium (also known as dilantin sodium). Other disorders of the nerves or of conduct not generally identified with epilepsy also have disturbances of brain rhythm. Of children with 'behavior problems,' inmates of prisons, the victims of migraine or of schizophrenia, a third or more have disordered brain rhythms." He stated that new possibilities of treatment are opened by these observations.

Near-sightedness could be eliminated, bred out of the human race, by banning marriages between near-sighted people, according to Dr. Lawrence T. Post, of St. Louis. The large number of near-sighted Germans today is probably due to the fact that such eugenic mating was not practiced in Germany. There is little evidence to show that this is anything but a hereditary defect and is handed down just as other physical characteristics are. Even if complete eugenic mating can not be achieved, it may at least be possible to prevent the marriage of two people afflicted with extreme near-sightedness. Besides eyeglasses to correct the near-sighted condition, Dr. Post advised the following treatment for the near-sighted child: "a well-rounded diet with a quart of milk or its equivalent in calcium each day; maintenance of a good posture, especially not stooping when reading, in which position the eye hangs by the optic nerve almost unsupported, as a grape from its stem; a good light, work at not too close a distance from the eyes, and if general examination indicates it, adequate dosage of thyroid."

Dr. Philip Cohen and Dr. Samuel J. Scadron, of New York, announced that new-born babies can be protected from whooping cough by vaccinating their mothers during the last three months before the babies are born. "Whooping cough is the dread contagious disease of infancy. During the first two years of life it is the cause of more deaths than measles, diphtheria, infantile paralysis and scarlet fever combined." Babies are usually born with an endowment from their mothers of immunity against these latter diseases, the immunity lasting about six months. Against whooping cough, however, they have no such protection and efforts to make them resistant to the disease by vaccination early in life have been unsuccessful. Apparently the new-born baby is not capable of producing antibodies against whooping cough, even under the stimulus of vaccination. But if his mother is vaccinated before his birth, defensive forces against whooping cough which develop in her blood are transferred through the womb to the baby. The importance of this new method of protecting new-born babies from whooping cough by vaccinating their mothers was emphasized

by the report that when this disease attacks a very young baby, it may prevent his normal mental and personality development. More than half of a group of 58 children who had had whooping cough before the age of two years showed "definite behavioral, intellectual and personality changes later in life, apparently as a direct result of this infection," according to Dr. Louis A. Lurie and Dr. Sol Levy, of Cincinnati. In most cases, the attack of whooping cough occurred between the third and seventh months of life, but the children were first brought to the Child Guidance Home at the ages of 10 and 11 years. Besides the behavior problems, ranging from incorrigibility to behavior indicative of mental disease, below-average intelligence was found in 24 of the 58 children and 10 were definitely feeble-minded. This amount of subnormal mentality is much greater than in the entire group of children at the Child Guidance Home. Dr. Lurie stated that in all probability the changes found "are due to definite organic lesions (injuries) produced in the brain during the attack of whooping cough."

Safer operations, with fewer complications and smoother convalescence, may be achieved with the aid of one of the new sulfa drugs, succinyl sulfathiazole, was reported by Dr. Edgar J. Poth, of Baltimore. This drug is given before and after operations on the lower part of the digestive tract, where chances for serious germ infection are especially great. Within one to seven days after starting to give this drug, the bacteria ordinarily found in the colon have dropped from an average of 10,000,000 to less than 1,000. The drug not only checks the growth of the bacteria, but actually kills them, it appeared from studies in which the decrease in numbers of bacteria could only be accounted for by their death, since they could not escape to other parts of the body.

Approximately 60 per cent. cures of alcoholism in 1,000 cases followed for from six months to six years after treatment were achieved by the "conditioned reflex method," according to a report made by Dr. Frederick Lemere, Dr. Walter L. Voegtlin, Dr. William R. Broz and Dr. Paul O'Hollaren, of Seattle. The patients are treated by injections of emetine, which produces prompt vomiting of imbibed alcoholic beverages which are urged on the patient for 30 to 45 minutes after giving the emetine. This is said to establish a reflex aversion to the sight, taste, smell and thought of alcoholic beverages. Reason why the vomiting many alcoholics do in the course of their drinking does not create the curative aversion to liquor is, it was explained, "that by the time the vomiting occurs the patient is foggy mentally and does not care much what happens to him. In order to establish a conditioned reflex the patient's mind must be clear." Patients under thirty years of age and women were especially difficult to treat, the relapse rate being over twice that of other patients.

Eating a reasonably good diet and taking extra vitamins in the form of pills or other preparations will not ward off colds or other infections of the upper part of the breathing tract. Studies showing this were reported by Dr. Donald W. Cowan, Dr. Harold S. Diehl and Dr. A. B. Baker, of Minneapolis. Tablets of synthetic vitamin C, the anti-scurvy vitamin of citrus fruits, were given daily to a group of 183 students at the University of Minnesota throughout the "cold season" of 1939–1940. Candy tablets of the same size, shape, appearance and taste as the vitamin C tablets were given to another group of 194 students. Students getting the vitamin C tablets had 1.9 colds per person during the season, as compared with 5.5 colds per person the previous year, a reduction of 65 per cent. The students getting the candy tablets, however, had a reduction nearly as great, 62.7 per cent., in the number of colds over the previous year. Statistically, this is a significant difference "and vitamin C supplement to the diet may therefore be judged to give a slight advantage in reducing the number of colds experienced." However, the practical importance of such a difference, it was stated, may well be questioned. The following year students were given not only vitamin C but also doses of vitamins A, D, B_1 and B_2. There was no difference in the number of colds among students getting these vitamins and those getting the candy tablets.

A greater risk of getting stomach ulcer comes from eating hurriedly, overeating, eating when tired, worried or angry than from eating any particular kind of food, according to Dr. Russell S. Boles, of Philadelphia. Only persons of a certain type will "produce an ulcer," Dr. Boles stated. This type is characterized by instability of the autonomic nervous system, which acts without conscious control. In some of these people, "outward calm may hide inner chaos. As a rule these individuals have effectual energetic personalities and they live in a constant state of excitement, anxiety, fear or some other emotional ferment." Dr. Boles's advice to ulcer-susceptible persons: Feel free to eat what agrees with you, but avoid eating it when tired or in a bad state of mind; generally speaking, alcohol and other irritants to the stomach should be used, if at all, in great moderation; tobacco should be restricted to not more than six cigarettes daily, and these should not be smoked on an empty stomach; rest after eating when possible and don't subject the nervous system to the effects of too great application of the mind and too little manual activity.

Babies of cigarette-smoking mothers apparently develop a tolerance to nicotine before they are born and are not affected by the nicotine that gets into the milk of all smoking mothers. Studies showing this were reported by Dr. H. Harris Perlman, Dr. Arthur M. Dannenberg and Nathan Sokoloff, of Philadelphia. The quantity of nicotine that would produce poisonous effects in an infant is not known. The first poisonous symptoms from nicotine, it has been shown, appear after the intake of one to four milligrams. The actual amounts of nicotine obtained in a feeding by the infants in the study were practically all below the poisonous threshold. No reduction in supply of milk was found in the 55 mothers who had all smoked before their babies were born and continued to smoke within two days after confinement.—JANE STAFFORD.